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Expanded austenite is produced from low temperature nitriding (<720 K), carburizing (<820 K) or nitrocarburizing of austenitic stainless steel [1]. This introduces nitrogen/carbon into the surface adjacent region and improves wear and fatigue performance. The surface hardness can be increased by an order of magnitude, while corrosion resistance is retained and may even be improved by the process.
In the present work in-situ synchrotron X-ray diffraction was applied to investigate thermal expansion and thermal stability of expanded austenite in the temperature range 385 - 920 K. Samples were produced from AISI 316 grade stainless steel powder by gaseous nitriding in ammonia/hydrogen gas mixtures or carburizing in acetylene/hydrogen or propene/hydrogen gas mixtures.
The highest obtained nitrogen content corresponds to an occupancy of the octahedral voids of Y_N=0.56. Previous EXAFS studies have shown Fe, Cr and Ni exist in different local environment with short range ordering between Cr and N [2]. As diffraction peaks do not fit ideally to FCC positions, a stacking fault probability was included as a fitting parameter in Rietveld refinements. The stacking fault probability is constant for temperatures up to 680 K, thereafter it decreases to nil. For nitrogen expanded austenite the decomposition products and the coefficient of thermal expansion depend on the initial nitrogen content. For high nitrogen contents a transitional FCC phase appears at temperatures above 770 K with lattice parameter $a \approx 3.8$ Å (y_N=0.25), suggesting a M_4N phase M=(Fe,Cr,Ni)
For carbon expanded austenite no stacking fault induced peak shifts were observed and decomposition produces first χ-M_5C_2 carbide which at higher temperatures is transformed to M_7C_3.

[1] T.L. Christiansen and M.A.J. Somers. *Metall. Mater. Trans A*. 2006, 37, 675-682.
[2] J. Oddershede, T.L. Christiansen, K. Stahl and M.A.J. Somers. *Scripta Mater*. 2010, 62, 290-293.

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